Sub-track II – Power & Energy Presentation
KNX energy management system

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Automation Competence Center
STMicroelectronics
1. KNX market and ST solutions
2. KNX energy management system
3. ST KNX EV charging station
4. ST KNX solutions and development process
KNX market and ST solutions
Buildings consume 50% energy by 2030

- Mendeley report: Buildings consume up to 40% of the total global energy. By the year 2030, the consumption is expected to increase to 50%. (1)
- PRWeb report: 30% of energy used in a commercial building is wasted because of inefficiencies. (2)

### GLOBAL KNX PRODUCT MARKET BY APPLICATION (USD MILLION) 2019-2031

<table>
<thead>
<tr>
<th>Application</th>
<th>2019</th>
<th>2020</th>
<th>2021</th>
<th>2022</th>
<th>2023</th>
<th>2024</th>
<th>2025</th>
<th>2026</th>
<th>2027</th>
<th>2028</th>
<th>2029</th>
<th>2030</th>
<th>2031</th>
<th>CAGR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lighting</td>
<td>11719.8</td>
<td>9380.9</td>
<td>12330.7</td>
<td>13299.7</td>
<td>14448.1</td>
<td>15669.8</td>
<td>16957.8</td>
<td>18427.5</td>
<td>20076.1</td>
<td>22011.4</td>
<td>24418.1</td>
<td>27421.7</td>
<td>30959.0</td>
<td>10.0%</td>
</tr>
<tr>
<td>Blinds &amp; Shutters</td>
<td>5052.7</td>
<td>4087.1</td>
<td>5372.3</td>
<td>5947.3</td>
<td>6452.2</td>
<td>7022.4</td>
<td>7662.3</td>
<td>8392.9</td>
<td>9206.4</td>
<td>10107.9</td>
<td>11125.4</td>
<td>12291.6</td>
<td>13615.5</td>
<td>9.8%</td>
</tr>
<tr>
<td>Security Systems</td>
<td>8466.9</td>
<td>7504.0</td>
<td>9863.5</td>
<td>10939.2</td>
<td>11768.7</td>
<td>12702.0</td>
<td>13744.1</td>
<td>14929.9</td>
<td>16241.5</td>
<td>17684.6</td>
<td>19304.5</td>
<td>21152.8</td>
<td>23239.3</td>
<td>8.9%</td>
</tr>
<tr>
<td>Energy Management</td>
<td>3258.7</td>
<td>2085.7</td>
<td>2741.5</td>
<td>2461.3</td>
<td>2663.0</td>
<td>2897.0</td>
<td>3171.4</td>
<td>3487.1</td>
<td>3843.9</td>
<td>4234.5</td>
<td>4649.3</td>
<td>5077.6</td>
<td>5529.2</td>
<td>9.6%</td>
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<tr>
<td>HVAC Systems</td>
<td>7388.2</td>
<td>5896.7</td>
<td>7750.8</td>
<td>8403.5</td>
<td>9057.3</td>
<td>9815.3</td>
<td>10704.2</td>
<td>11725.1</td>
<td>12876.0</td>
<td>14130.8</td>
<td>15456.0</td>
<td>16815.8</td>
<td>18241.3</td>
<td>9.1%</td>
</tr>
<tr>
<td>Monitoring Systems</td>
<td>1407.0</td>
<td>1138.1</td>
<td>1496.0</td>
<td>1461.3</td>
<td>1579.5</td>
<td>1716.5</td>
<td>1877.3</td>
<td>2062.2</td>
<td>2271.0</td>
<td>2499.3</td>
<td>2741.4</td>
<td>2991.1</td>
<td>3253.9</td>
<td>9.5%</td>
</tr>
<tr>
<td>Remote Control</td>
<td>1855.8</td>
<td>1501.1</td>
<td>1973.1</td>
<td>2162.7</td>
<td>2311.7</td>
<td>2476.4</td>
<td>2659.5</td>
<td>2867.8</td>
<td>3098.2</td>
<td>3355.4</td>
<td>3646.4</td>
<td>3973.7</td>
<td>4334.4</td>
<td>8.2%</td>
</tr>
<tr>
<td>Metering</td>
<td>1863.4</td>
<td>1498.5</td>
<td>1969.8</td>
<td>2175.1</td>
<td>2337.9</td>
<td>2521.0</td>
<td>2725.3</td>
<td>2957.8</td>
<td>3214.7</td>
<td>3497.1</td>
<td>3814.0</td>
<td>4175.4</td>
<td>4583.2</td>
<td>8.8%</td>
</tr>
<tr>
<td>Audio/Video Controls</td>
<td>3912.7</td>
<td>3247.7</td>
<td>4268.9</td>
<td>5114.4</td>
<td>5528.1</td>
<td>6009.8</td>
<td>6570.4</td>
<td>7203.0</td>
<td>7881.5</td>
<td>8610.4</td>
<td>9381.1</td>
<td>10202.5</td>
<td>11084.7</td>
<td>9.1%</td>
</tr>
<tr>
<td>White Goods</td>
<td>1975.6</td>
<td>1598.0</td>
<td>2100.5</td>
<td>2101.9</td>
<td>2263.9</td>
<td>2446.2</td>
<td>2649.9</td>
<td>2881.8</td>
<td>3138.5</td>
<td>3421.2</td>
<td>3738.8</td>
<td>4101.4</td>
<td>4511.0</td>
<td>9.0%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>46900.8</td>
<td>37937.9</td>
<td>49867.2</td>
<td>54066.4</td>
<td>58410.4</td>
<td>63276.3</td>
<td>68722.2</td>
<td>74935.1</td>
<td>81847.8</td>
<td>89552.6</td>
<td>98275.1</td>
<td>108203.7</td>
<td>119351.5</td>
<td>9.3%</td>
</tr>
</tbody>
</table>

- Global KNX products market size by 2031 will be above 119B$. Growth CAGR is around 9.3% (2019-2031).
- The market for Semi-conductor in the KNX Energy Management application is projected to reach **USD 130.9 million** for 2023 in Asia.
- WW TAM for KNX energy management product market in 2023 is 2.6B$ and will double by 2031 at 5.5B$
KNX in smart home and building automation

KNX is an open worldwide standard for home and building automation covering a range of products from many manufacturers

Approved standard:
• International standard (ISO/IEC 14543-3)
• European standards (EN 50090, EN 13321)
• US standard (ANSI/ASHRAE 135)
• Chinese standard (GB/T 20965)

*Data by February 2022
## Connectivity medium options

**ST delivers twisted pair wired and RF wireless solutions**

<table>
<thead>
<tr>
<th>Medium</th>
<th>Transmission via</th>
<th>Preferred areas of application</th>
</tr>
</thead>
</table>
| **Twisted pair** | Separate control cable         | • New installations  
• Extensive renovations  
• Highest level of transmission reliability                                                   |
| **Radio frequency** | Radio line                  | • When no cable can be installed                                                               |
| **IP**           | Ethernet/WIFI                 | • In large installations where a fast backbone is needed  
• For communication with mobile devices                                                      |
| **Powerline**    | Existing network (neutral conductor must be available) | • If no additional control cable can be installed  
• When 230 V cable is available                                                             |
STKNX transceiver device for KNX TP communication; small package and few external components enable the very compact KNX nodes

- KNX certified, KNX TP1-256 supported.
- Very small system solution
- Supports bus current up to 30mA (fan-in 3)
- Easy "Bit" interface to µC
- No crystal required
- 2 integrated voltage regulators for external use in application.
  - Selectable 3.3V / 5V – 20mA linear regulator
  - Adjustable 1V to 12V – 150mA high efficiency DC/DC switching converter
- Recommended list of passive parts is supplied in datasheet and schematics
Smart building automation
ST Shenzhen office sustainability project

Pilot Zone: demo testing area

Click here to watch the demonstration

Home assistant dashboard
KNX energy management system
**KNX applications in energy management**

- **Lighting**
- **Heating, Ventilation & Air conditioning (HVAC)**
- **Blind and Shutter Control**
- **Automation and Remote Access**
- **Security and Safety**
- **Operation and Visualisation**
- **Energy Management/Smart Metering**
- **Other**

**KNX energy Management**: metering, data logging, visualization, current detection, fuel, or water tank level control, peak demand monitoring, load shedding, energy harvesting, renewable energies, battery storage
## KNX vs RS485 comparison

<table>
<thead>
<tr>
<th></th>
<th>KNX</th>
<th>RS485</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Protocol</strong></td>
<td><strong>International standard</strong></td>
<td>Proprietary protocol(DMX512/Modbus etc.)</td>
</tr>
<tr>
<td></td>
<td>(KNX SW/HW/Association/Protocol/Cable/IC)</td>
<td>Physical layer (Electrical regulations)</td>
</tr>
<tr>
<td><strong>Interoperability</strong></td>
<td><strong>Good</strong></td>
<td>Need protocol docking and connector matching</td>
</tr>
<tr>
<td><strong>Modulation</strong></td>
<td><strong>Modulation voltage up to 7V</strong></td>
<td>Differential line with mV</td>
</tr>
<tr>
<td><strong>Anti-static ability</strong></td>
<td><strong>Strong anti-static ability</strong></td>
<td>Sensitive to static electricity</td>
</tr>
<tr>
<td><strong>Device Power</strong></td>
<td>KNX bus communication and power supply(&lt;0.6W), Auxiliary power function</td>
<td>Need additional external power supply</td>
</tr>
<tr>
<td><strong>Stability</strong></td>
<td>Carrier monitoring capability, <strong>more stability</strong></td>
<td>Without carrier monitoring function</td>
</tr>
<tr>
<td><strong>Network structure</strong></td>
<td><strong>Bus, Tree, Star</strong></td>
<td>Bus(Single master slave structure)</td>
</tr>
<tr>
<td><strong>Network capacity</strong></td>
<td><strong>65536</strong></td>
<td>255(Typical)</td>
</tr>
<tr>
<td><strong>Security</strong></td>
<td><strong>KNX Date Secure &amp; IP Secure</strong></td>
<td></td>
</tr>
</tbody>
</table>
Enablers of KNX energy management

- KNX gateway for solar panel inverters
  - Elausys link

- A high-tech storage system that allows to cover about 75% of the yearly energy requirement with self-produced and clean energy
  - Sonnen link

- Dynamic load management and SMART CONNECT KNX e-charge II. Easily integrate up to 5 charging points from different manufacturers into the KNX.
  - iSE - link

Source: KNX | energy management (sustainabilityknx.org)
KNX with other protocols for energy planning using the grid or solar inverter

- E-HAUS HEMS (home energy management systems) show real-life appliances being managed by the Alexander Maier Eisbae.
- Multiprotocol gateway visualization, allowing KNX to be mixed with other protocols.
- Examples of different functional models were shown, such as EV charging and home energy planning.*

*source: www.knxtoday.com
55 KNX communication objects and 18 UART communication command have been included.

Use case:

Temporary solution: KNX Module connect

Future solution: STKNX on board
KNX use cases in energy management

**Sources:**
- KNX Org.
- XXTER KNX Smart Energy Management
- HDL KNX Battery Energy Storage System
- EibPC2 KNX Home Energy Management
- Elausys KNX gateway for Huawei Inverters
- Sonnen KNX Module for Smart Home Energy
- myGEKKO Energy Manager
**KNX energy management selling points**

- **Reduce Energy Costs**: Reduce energy costs up to 30% by optimizing energy usage
- **Optimize Energy**: Maximize the use of self-generated solar energy
- **Smart Charging**: Charge your electric vehicle and other devices when energy demand and prices are lowest
- **Smart Scheduling**: Run appliances when energy demand and prices are lowest
- **Carbon Reduction**: Reduce your carbon footprint

- **KNX Interface for Huawei SUN2000 inverter series**
- **Monitoring of** Energy, Power, current, voltage, frequency, temperature,…
- **Connected to the inverter over Ethernet**
- **Galvanic insulation** from the KNX bus
- **Configurable** refresh rate of inverter data
- **DIN rail mounted and Auxiliary power supply 12-30VDC**
- **Advanced Logic functions** including weekly calendar, sequences, math, logic gates and triggers
- **Different KNX devices from different vendors** communicate without any problems

Sources: [KNX Org.](#)
ST KNX EV charging station
2. **10.5 million** new BEVs & PHEVs were delivered during 2022 in global. By the end of 2023, expect **40 million** EVs in operation.
3. Global sales of chargeable vehicles (**10.5 m**) were higher than for non-chargeable vehicles (**8.4 m**) for the first time in 2022.
4. KNX Association sees integrating EV charging as an important part of the energy management of homes and buildings.
5. There are already KNX devices launched by KNX Members that allow a range of charging station brands to be connected to KNX, including already stations from ABB, ABL, ebee, KEBA, Mennekes and Stöhr.
6. Singapore’s vision to have all vehicles run on cleaner energy by 2040.
7. **60,000** EV charging points by 2030, **40,000** charging points in public carparks and **20,000** charging points in private premises.

Sources: *1. EV volumes;  *2. KNX Org.  *3.LTA*
EV charging in parking space today

Maximizing idle charging stations usage with KNX energy management system

EV Cars are similar to parking space for people with disability

There are more Parking Space than EV charging Parking Space

With KNX energy management system, we can maximize the usage of EV charging pile and number of EV car coverage per parking lots
1. The EV market is clearly growing, and the demand for charging vehicles whilst at work/home will increase as the market expands.
2. KNX provides the mechanism to do this intelligently and securely, by integrating the charging of EVs within an energy management system that already covers all aspects of a home or building’s energy consumption and generation.
3. **07B0h KNX stack** is a recommend KNX configuration profile for EV charging station device, more than 2000 communication objects & parameters are supported by this profile.

Sources: [KNX Org.](https://www.knx.org)
Charging station in KNX smart parking energy management system

Note: need to check the Charging port standard required in the country of installation

**AC Source**

Dual power automation transfer switch

**DC Source**

200-750VDC

**AC Source**

AC220V±15%

DC EV Charger Station (120KW)

AC EV Charger (230Vac, 3/7/912KW)
(400Vac, 11/22KW)

----More EV charging Station can interconnect

**KNX Energy Management System:**

1. Provides **Status** and **Power consumption** of Charging
2. Start/Stop Charging based on **NFC/RFID**
3. Different automation **power sources** switch
4. Automatic distribution of **charging current**
5. Provides management of Energy from one Charging Station to another
6. Improves **Intelligent utilization** of Charging station reducing the idle EV chargers in peak hours
7. KNX **Secure** adds more protection in the IP and data transfers
8. Up to **65,000** nodes can be manage by KNX
9. Visualizing for charging progress, payment and error reporting, etc..
10. And more.....
KNX energy management system solution

Example of KNX System

Gen. smart meter

35 A

Charging point 1

Charging point 2

Charging point 3

Charging point 4

Charging point 5

7 A

7 A

7 A

7 A

7 A
ST KNX solutions and development process
Activity and tools for KNX product development

- Apply to KNX member
- Select KNX chip
- Select KNX stack profile
- KNX application development
- ETS database development
- KNX product certification
- ETS
- EITT
- KNX MT
1. Get Shu Fan KNX stack project

2. Refer to SHUFAN KNX Stack user manual for KNX Part FW design

**KNX stack occupied resource:**
- ROM: about 42K with no optimization
- RAM: about 8.5k
- 2 Timers are used.
3. Create S19 file via S19 Generation tool

MakeKnxS19_ST_stm32xxx.exe

4. Refer to Shufan KNX Tool reference specification for creating ETS database.
SHUFAN stack plus STM32G070CB

5. Through STM32CubeMax or STM32Cube_FW integrated with other HW driver code.

6. Develop product application control logical part. Most of development effort will focus on this part.
21IC training center for automation

https://www.21ic.com/stpower/training_center/#videoAutomationC

- Lots of training for AUTOMATION, especially for HBA and FA based on KNX and IO-Link technology...

ST KNX solution contributes to the sustainable development target

Home and building automation – Internet of Everything

ST KNX-RF solutions

How to quickly develop a KNX product based on ST KNX and STM32G0 MCU

STMicroelectronics Industrial automation and robotics solution

How to quickly develop a KNX product based on ST KNX and STM32G0 MCU

ST KNX solution contributes to the sustainable development target

Home and building automation – Internet of Everything

ST KNX-RF solutions

How to quickly develop a KNX product based on ST KNX and STM32G0 MCU
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